

NASA Dryden Flight Research Center White Paper

ChemSecure Sensor-Based Technologies and Hazardous Material
Management System (HMMS) Integration Project with Local and
Deployment Capabilities, September 2004 Rev. 1.5

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EXECUTIVE OVERVIEW

NASA Dryden began this pilot May 4th 2004 and expects to complete Phase 1 by September 30th, 2004. The pilot dubbed as *ChemSecure* will leverage existing sensor-based technologies with our web-based hazardous material management system (HMMS). This continual improvement effort was made possible through the Cooperative Research and Development Agreement (CRADA) between the Air Force HMMS Program Management Office and the HMMS technical support contractor. Dryden's relationship with the HMMS Program Management Office is to support project management and systems integration. *ChemSecure* will not radically change existing business practices, it will enhance them. Dryden will assess and challenge sensor-based technologies against rigorous government standards. As the systems integrator, Dryden will provide an efficient means to package and transfer this technology to government and industry so it may be utilized by all enterprise management systems, based on a standardization approach.

This effort was made possible due to the partnering and expertise brought to forth by NASA Dryden, DoD, and Industry. The industry partners include, Oracle Corporation, Intermec Corporation, EnvironMax Corporation, and QTechnology Incorporated. Funding opportunities are being sought from all of the *ChemSecure* partners.

The expected output of phase 1 of the *ChemSecure* project is to provide automatic alerts and notifications to Security, Safety, Health and Environmental professionals. These alerts include text messaging and voice alerts, which will capitalize on cellular phone service, and delivery of email to desktops, or provide interactive data to Intermec's hand-held devices. Such examples include notifying security professionals when unauthorized access attempts are made to obtain highly hazardous materials, and to environmental professionals when the storage capacity limit of a hazmat locker is about to be exceeded. Detailed sections of the Material Safety Data Sheet will be pushed to the Intermec handheld device, and will provide data required by Health and Safety professionals needed to assist them with timely and critical decisions so that corrective actions may be taken. Notifications will also be implemented to prevent incompatible storage of chemicals, which will improve chemical shelf life management.

The Safety, Health and Environmental office will integrate the sensor-based technology into Dryden's production environment as quickly as possible to be a model for the NASA agency and government facilities. *ChemSecure* will operate in short burst phases lasting approximately three months per phase.

CHEMSECURE VISION FOR TODAY

The vision of the *ChemSecure* model is shared throughout federal facilities. And, because this technology can be used to manage all types of assets, it is a supporting and enabling function to all of NASA Dryden's Strategic Enterprises.

Dryden along with the other *ChemSecure* partners will identify, integrate and deploy strategies that meet the data requirements of critical incident responders, emergency first responders, law enforcement, medical personnel and fire professionals by providing technological solutions for management, detection, protection, decontamination, mitigation, containment and disposal of hazardous materials and hazardous waste.

NASA Dryden Flight Research Center is providing system's integration, and test bed facilities while Oracle's Sensor-Based technology provides a comprehensive set of capabilities to capture, manage, assess, analyze and respond to data collected from the sensors. Intermec Corporation will provide the readers, antennas and hand held devices that will provide stand off read capability and automated data collection. EnvironMax Corporation will ensure that the roadmap defined for our RFID solution is supported in the HMMS product. QTechnology Incorporated will provide technical assistance during the systems integration of this RFID and sensor-based technology project and the HMMS Program Management Office is providing the overall program management.

Additional federal agencies that will benefit from this technology include The Department of Homeland Security, the Department of Defense, the Department of Transportation, the Environmental Protection Agency, the Occupational Safety and Health Administration and the Department of Justice.

SENSOR-BASED TECHNOLOGIES AND NASA DRYDEN

Dryden will introduce multiple sensor-based technologies into the *ChemSecure* project to test and validate the operational readiness of this technology. The combination of RFID tags, along with temperature sensors, will provide monitoring capabilities inside chemical storage lockers and send voice and text alerts when the temperature range has deviated from the specified range. Utilizing RFID capabilities will not only align with NASA Dryden's current strengths in Environmental Management, it will create a more dynamic Environmental Management System.

The Safety, Health and Environmental Office invested early in the highest rated Hazardous Material Management System (HMMS) being utilized at some of the largest DoD depots. Dryden implemented the HMMS system in 1994, prior to that Dryden's overall chemical management system evolved from a manual tracking and inventory system to a well-integrated bar code application. The web-based version of HMMS was introduced around the 4th quarter 2003. Dryden was the first site to go live with this premier HMMS 4.0 web-based application. The HMMS Program Management Office has recognized Dryden for its leadership and environmental management capabilities and as a result advocated for our center to be the lead in the *ChemSecure* pilot project.

RFID BACKGROUND AND ATTRIBUTES

RFID technology has been around since the 1940s and has been used for such automated tasks as highway toll collection and used in key chain devices to open car doors. Radio frequency identification, or RFID, is a generic term for sensor-based technology that uses radio waves to automatically identify people or objects. There are several methods of identification, but the most common is to store a serial number that identifies a person or object, and perhaps other information, on a microchip that is attached to an antenna (the chip and the antenna together are called an RFID transponder or an RFID tag). The antenna enables the chip to transmit the identification information to a reader. The reader converts the radio waves reflected back from the RFID tag into digital information that can then be passed on to computers for use.

- RFID tags can hold more data than traditional bar codes and do not require people to position scanners directly on tags to read the information

- Active RFID systems send out locator signals and function like a global positioning system
- RFID uses the low-end of the electromagnetic spectrum. The waves coming from readers are no more dangerous than the waves coming to a car radio
- RFID tags have applications for DNA and genomic specimens which are too delicate to mark with bar codes

PHASE 1: TECHNICAL APPLICATIONS AND CAPABILITIES OF PILOT

The *ChemSecure* pilot will utilize a development environment for all testing and passive tags will be applied to various types of containers mimicking highly hazardous materials. These tags will be encoded with only unique serial numbers and no information about the product itself is stored on the tag. The information about the product can be revealed only when the tag is in the range of a reader and proper authentication is made to the database.

Readers and antennas will be strategically placed in two locations at the Center to capture the data moving from inventory control to storage. Varying level of security alerts will be tested based on chemical composition, and quantity of material. Light stacks will provide visual identification when all systems are go as well as to provide notification to prevent honest, simple mistakes and to allow personnel to correct the situation.

The *ChemSecure* pilot will leverage the data collected from the RFID tags as it passes through various readers to ensure real-time intelligent processing is implemented. It automatically cross-checks back to Oracle's Edge Server and the HMMS database where all the enforcement of the Dryden chemical management business processes reside. This prevents unreleased chemicals from making it into the wrong hands, or prevents chemicals from being stored in adverse thermal conditions. Hand held devices are one such peripheral used as a remote reader. All users of the HMMS application and its peripherals will require username/password authentication, the combination of username/password will accurately distinguish the individuals and their positions at Dryden, such as an Incident Commander.

Project *ChemSecure* will validate against eight distinct scenarios to fully qualify that sensor-based technology supports our existing business practices by ensuring personnel are working in authorized workspace, chemicals are properly stored in proper hazmat lockers, and personnel are properly licensed, trained and authorized for the chemical they intend to use.

First responders that enter a chemical spill area will have the ability to interrogate the container to identify the contents. A panic button will also be available on the handheld devices to provide wireless interaction to the database. Toxic information can be sent to a hand held device if the Health Unit requires more information to better understand the signs and symptoms of exposure. This type of information resides in the HMMS database.

Dryden has multiple organizations engaged in this effort to ensure the highest level of technical support, such as IT Security, and Frequency Control Management.

PHASE 1: BENEFITS

Agency wide there is the possibility to save x millions in proper container tracking, x millions in avoiding stock outs, x millions through better tracking our

Department of Transportation waste loads, x millions saved by theft, error, and fraud, x millions in reduced liabilities, x millions by eliminating the need to have people scan barcodes.

Increased Safety

- Provides first-aid and critical data to first responders and decision makers so they are equipped to make appropriate and timely decisions necessary for the safety, security and protection of people, physical assets and the environment during an emergency evacuation involving a chemical spill
- Ensures Chemicals are placed in appropriate and safe locations such that there are no adverse reactions to other chemicals
- Increase security – Monitoring of the actual person bringing or leaving with the container and crosschecking accuracy with the container itself
- Verifies person and chemical are scanned and verified thus reducing theft, error, and fraud.

Increased Security

- Manages hazardous material/waste tracking, producing real-time end-to-end visibility.
- Determines authorization and training of employee carrying the chemical
- Validates chemical storage location
- Protection and Security for all transactions captured via RFID tracking
- Strong Audit Capabilities
- Mobile and Wireless notifications

PHASE 2: PILOT

Phase II of the ChemSecure Pilot will address the more dynamic applications of using sensor based technology with Chemical Management. These applications will continue to increase safety and security, but will have added benefits. Such benefits include but are not limited to, real time inventory tracking, monitoring all vehicles entering/leaving unguarded access points, integrating technology into enterprise information system(s), and full inventory management throughout the facility. The sensory based benefits of this phase will track all climate controlled chemicals time in and time out of a controlled environment, alert appropriate personnel of possible spills, track if storage reaches capacity and prevent additional chemicals from being added to the location, and will check for tampering/opening of a locked storage locker or transporters rig. The technologies will also be capable of overriding the system for mistakes, integrating Electronic Waste Manifest, identifying all inventory placed in a truck and broadcasting to emergency responders in a stand off position in case of a spill.

Please note that all items in this phase will be considered for implementation as technology becomes available. Full Cost proposals will be developed as more details in phasing options become available.

Vision Future

Although this white paper deals mainly with the Safety Health and Environmental capabilities of RFID technology, the technology has many other possible applications. The following table lists a few of these applications.

Other Possible Applications	Examples
Logistics Management	Integrated Asset Management (IAM)
Space Exploration	Tagging samples as they are collected with real time data
Medical Applications	Medicine Expiration
UAV	Help in Tracking and Emergency Response
Flight Safety	RFID tags in tools and support equipment can ensure they are not left inside vehicles and other assets.

NEW TRENDS

The U.S. Food and Drug Administration announced in February it will be requiring bar codes on labels of commonly prescribed drugs and biological products. The FDA estimates that will prevent nearly 500,000 complications and medical errors over 20 years, with a savings of \$93 billion in reduced health-care costs, patient pain and suffering and lost work time. (Source: CBS Market Watch, July 8th 2004)

Microwave Radio Frequency Identification (RFID) tags are used in long range access control for vehicles, an example being General Motors' OnStar system. (Source: CBS Market Watch, July 8th 2004)

In January 2003, Michelin announced that it has begun testing RFID transponders embedded into tires. After a testing period that is expected to last 18 months, the manufacturer will offer RFID-enabled tires to car-makers. Their primary purpose is tire-tracking in compliance with the United States Transportation, Recall, Enhancement, Accountability and Documentation Act (TREAD Act). (Source: CBS Market Watch, July 8th 2004)

ADT will monitor your RFID Readers. The security company wants to leverage the engineering and services units of parent company Tyco Fire & Security to create an organization that can install and service large-scale RFID deployments. (Source: RFID Journal July 8, 2004)

CONCLUSION

NASA Dryden has evolved from a manual tracking and inventory system to a well-integrated bar code application. As a result of the ChemSecure pilot Dryden can take the next step in using all the services and features of a sensor-based system. Through participation in follow-on phases, Dryden will continue to improve the performance, scalability, and capability of its Environmental Management System. Dryden has always been committed to providing the highest performing, integrated solutions to asset management. RFID technology will allow Dryden to continue this commitment, without radically changing or requiring elimination of existing business practices. The technology offers a foundation for future cost-effective computing and asset management.

The phased approach allows for the individual implementation of single capabilities into Dryden's Integrated Management Systems.

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